

REMARKS

The Examiner Lynne Ann Gurley is thanked for carefully examining and reviewing the subject patent application. The specification has been currently amended for informalities. Both the claims and specification have been reviewed and have been amended in accordance with all of the Examiner's kind suggestions.

The Examiner's Final restriction requirement is acknowledged, and non-elected claims 31 and 32 have been cancelled, in prior action. Applicant reserves the right to file a Divisional application at a later date.

The Examiner is thanked for considering Applicant's arguments as persuasive in the previous Office Action and for withdrawing the final rejection.

The specification has been currently amended for informalities. CF3 has been corrected to read CHF3 in the Specification and the claims. Applicants submit that a skilled addressee would appreciate that CF3 is an unbalanced formula and that there is an error in the formula. CHF3 is commonly used as an etching gas for materials such as SiO2 and USG which is mentioned in the description as a candidate for HM1. Therefore, it would be immediately obvious to a skilled addressee that CF3 should be corrected to CHF3.

All claims 1 through 30 are now believed to be in allowable condition, and allowance is so requested.

Claims 3, 4, 8, 11, 12, 19, 22, 23, and 30 have been amended to improve wording of the claims. Claims 5, 13, and 24 have been amended to delete repetitions and acronyms. Claims 7, 15, and 26 have been amended to delete acronyms and to reference antecedents correctly.

New Claims

New claims 33-35 have been added. No new matter has been introduced by these new claims which are supported by page 13, paragraph 2 and page 14, paragraph 2 of the description.

The new claims as exemplified by claim 33, define an added step of recessing the via-fill material to control fence or sub-trench profile, wherein the recessing can be performed after etching the via-fill material to form trench openings and/or after etching HM1 to form trench openings. As discussed on page 14, paragraph 3, the recessing of the via-fill material helps to minimize fence or sub-trench profiles.

CLAIM REJECTIONS – 35 U.S.C. 103(a):

Claims 1 – 30 are rejected under 35 U.S.C. 103(a), as being unpatentable over Weidman et al. (US 2003/0176058, hereinafter “Weidman”) in view of Wang et al. (US 2005/0110152, hereinafter Wang).

Applicants, have, by way of this response amended independent claims 1, 9 and 20, as exemplified in claim 1, to more clearly define the invention.

In particular, claim 1 as amended clarifies a limitation not found in both Weidman and Wang:

- “(e) patterning the intermetal dielectric layer and hard mask layers, and etching to form via openings extending through the intermetal dielectric layer and the hard mask layers;
- (f) forming a layer of via-fill material of bottom anti-reflective coating with photoresist over the intermetal dielectric layer, the via-fill material ~~and~~ filling the via openings;
- (g) patterning the via-fill material, intermetal dielectric layer and hard mask layers, and etching to form trench openings;
- (h) stripping-off the via-fill material after forming the trench openings., thus forming open trench and open via regions for subsequent conducting metal fill. ”

No new matter has been added by way of this amendment which is supported by Figs. 2A-2C and pages 11-12 of the description.

The above amendment clarifies that in the present invention, via openings 28 (see Fig. 2A) extending through the intermetal dielectric layer 23 are first formed and then filled with a via-fill

material 26 of bottom anti-reflective coating with photoresist. Trench openings are subsequently formed by etching the via-fill material, hard mask layers and dielectric layer.

By contrast, in Weidman, an opening 32 extending only through the second hard mask layer 22 is first formed (see Fig. 1A of Weidman) and then filled with a BARC coating 40. The BARC coating 40 does not fill a via opening extending through the intermetal dielectric 10 as required by claim 1. In fact, the BARC coating 40 is used as a mask when etching a via opening 50 through the intermetal dielectric 10 (see fig. 1E).

Furthermore, the photoresist layer 42 and BARC 40 are removed, leaving a partially formed via 50 and a larger opening 32 (see Fig. 1F, para [0011]). The via 50 and desired trench 52 are then formed by etching them simultaneously. Therefore, unlike claim 1, a via opening extending through the intermetal dielectric is definitely not formed before the patterning and etching of trench openings. Accordingly, claim 1 is novel over Weidman.

Referring to paragraphs [0025]-[0027], Wang discloses forming an opening 222 within a hard mask layer 214 and metal hard mask layer 212 (see Fig. 2C). A BARC material layer is then formed on the patterned hard mask layer 214a, filling the opening 222. Therefore, unlike the present invention as defined in claim 1, the BARC coating 24 does not fill a via opening extending through the intermetal dielectric 204, 208 as required by claim 1. In fact, the BARC coating 24 is used as a mask when etching a via opening 232 through the second dielectric 208 (see fig. 2E).

Additionally, as disclosed in paragraph [0029] and Fig. 2G of Wang, a damascene opening 234 is formed by simultaneously etching the trench opening 234a and the via opening 234b. Therefore, unlike claim 1, a via opening extending through the intermetal dielectric is definitely

not formed before the patterning and etching of trench openings. Accordingly, claim 1 is novel over Wang.

In view of the above, claim 1 is patentable over Weidman in view of Wang, since neither Weidman nor Wang, alone or in combination, discloses the features of claim 1.

“[T]he prior art reference (or references when combined) must teach or suggest all the claim limitations. *In re Vacek*, 947 F2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)”

The application of a bi-layered hardmask, deposited directly on top of an inter-metal dielectric (IMD) film stack to a “via first” dual damascene process helps to provide uniform trench depth as well as prevent corner chopping (see page 14, paragraph 2). The Applicants discovered these problems and the Applicants’ claimed invention uniquely solved these fencing and faceting problems. Therefore, the claimed combination defined in claim 1 provides a special technical effect and is patentable.

Accordingly, the other independent claims 9 and 20 which have been amended in a similar manner as claim 1 are also patentable over Weidman in view of Wang. The same applies to the remaining dependent claims which are directly or indirectly dependent upon claims 1, 9 or 20.

FINAL REMARKS

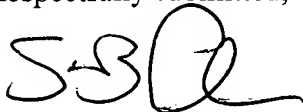
The Examiner Lynne Ann Gurley is thanked again for examining and reviewing the subject patent application. The claims and specification have been reviewed and both the specification and the claims have been amended in accordance with the Examiner's kind suggestions.

All rejected claims 1 through 30 are believed to be in allowable condition, and allowance is so requested.

Applicants respectfully request that a timely Notice of Allowance be issued in this case.

It is requested that should there be any problems with this Amendment, please call the undersigned Attorney at (845) 452-5863.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'SBA', with a stylized flourish extending from the end.

Stephen B. Ackerman, Reg. No. 37,761